

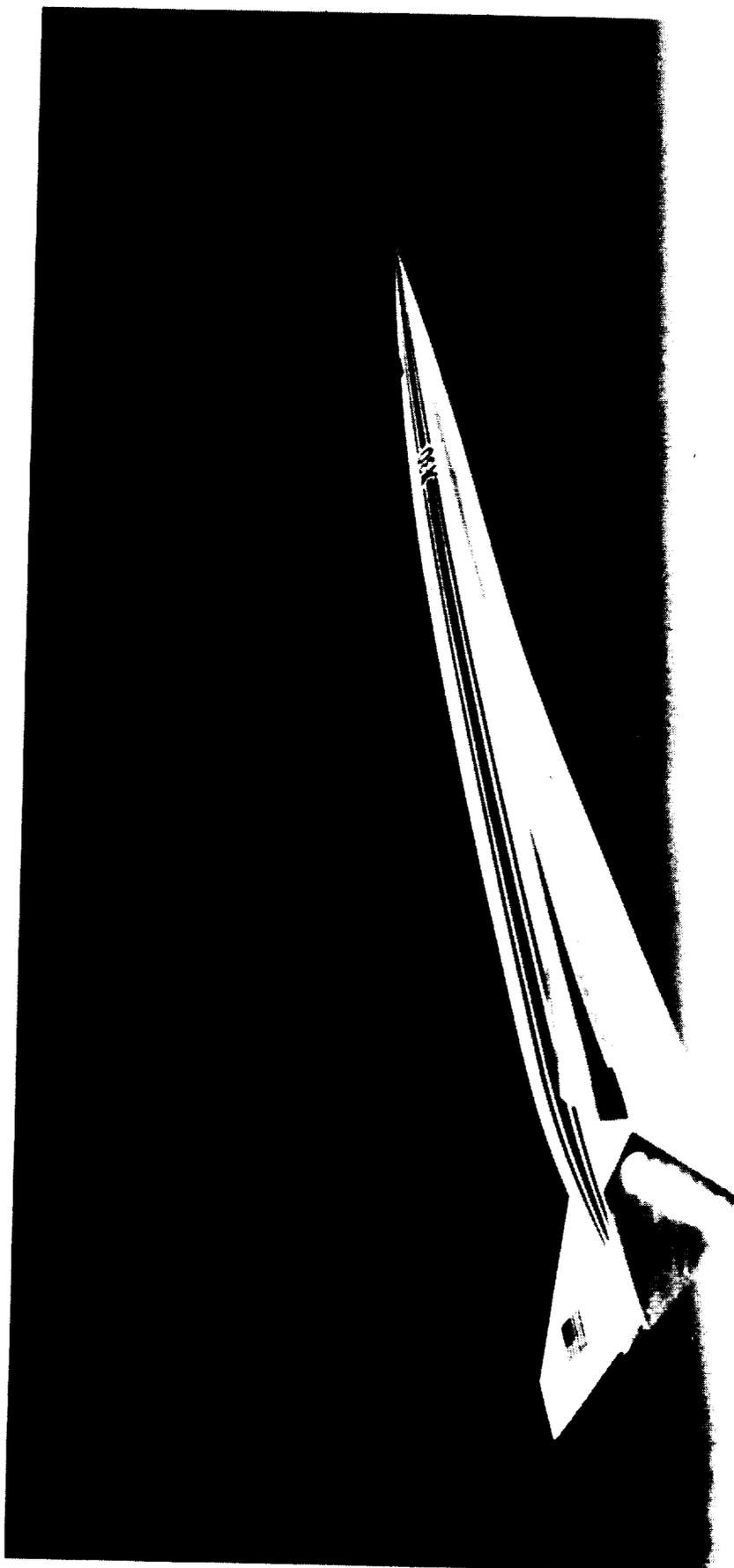
900

**N91-28214**

**NATIONAL AERO-SPACE PLANE  
(NASP) PROGRAM**

**PENNSYLVANIA STATE UNIVERSITY  
JUNE 26-29, 1990**

**MING H. TANG  
Deputy Director, NASP NIO  
Pentagon**



# NATIONAL AERO-SPACE PLANE

A PROGRAM TO DEVELOP THE TECHNOLOGY FOR REUSABLE  
AIRBREATHING HYPERSONIC/TRANSATMOSPHERIC VEHICLES

VALIDATE TECHNOLOGY BASE BY MID-1990'S ON  
THE GROUND

- AIRBREATHING PROPULSION
- ADVANCED MATERIALS
- CFD
- ACTIVELY-COOLED STRUCTURES

AND WITH AN EXPERIMENTAL VEHICLE

- HORIZONTAL TAKEOFF / CONVENTIONAL RUNWAY
- SINGLE-STAGE TO ORBIT
- HYPERSONIC CRUISE

PROVIDE OPTIONS FOR NEXT GENERATION OF AEROSPACE  
VEHICLES

CAST

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OF POOR QUALITY

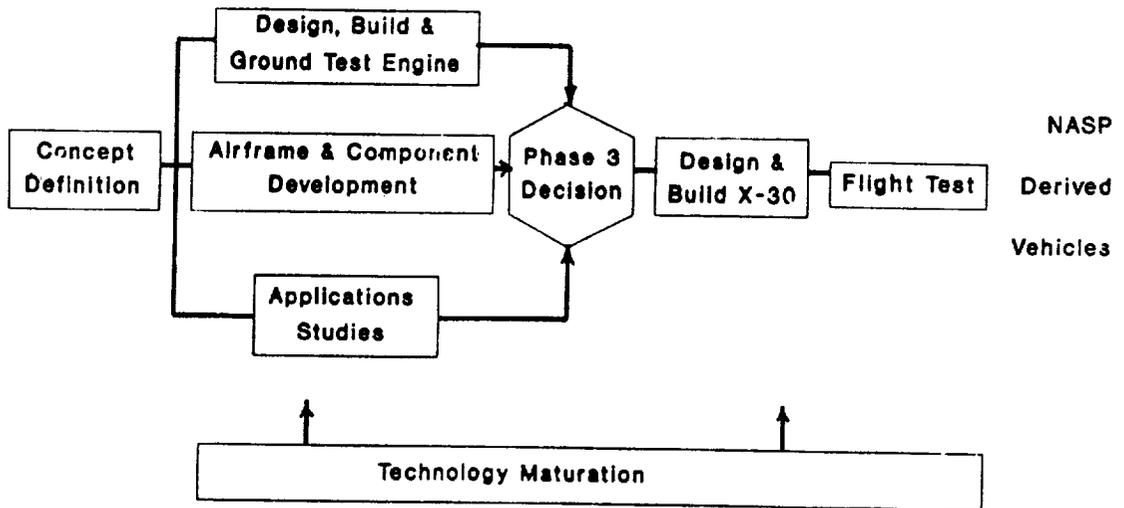
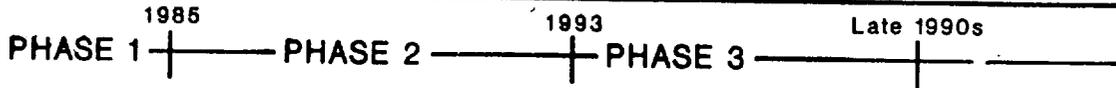




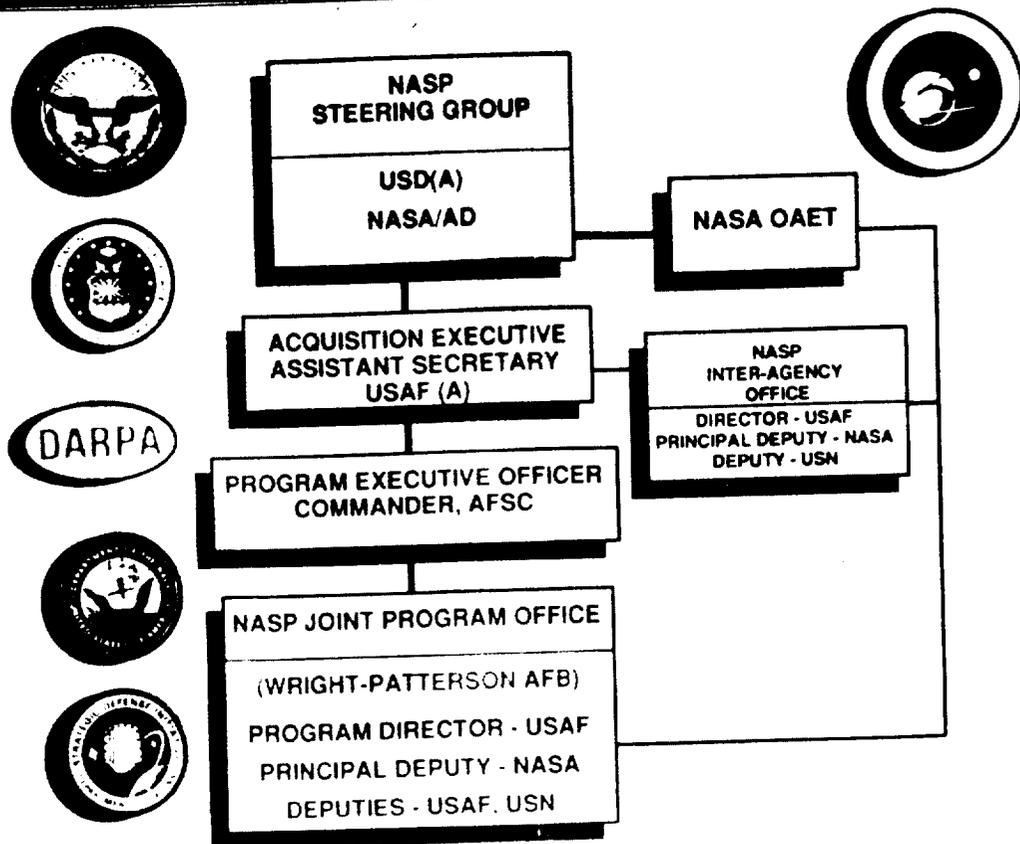
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# NASP PROGRAM SCHEDULE



# NATIONAL AERO-SPACE PLANE PROGRAM ORGANIZATION





# Competitive Strategy

## Phase 2

### Engine

General Electric  
Pratt & Whitney  
Rocketdyne

→ E  
→ C  
- - - - - R

Pratt & Whitney  
Rocketdyne

National  
Team

### Airframe

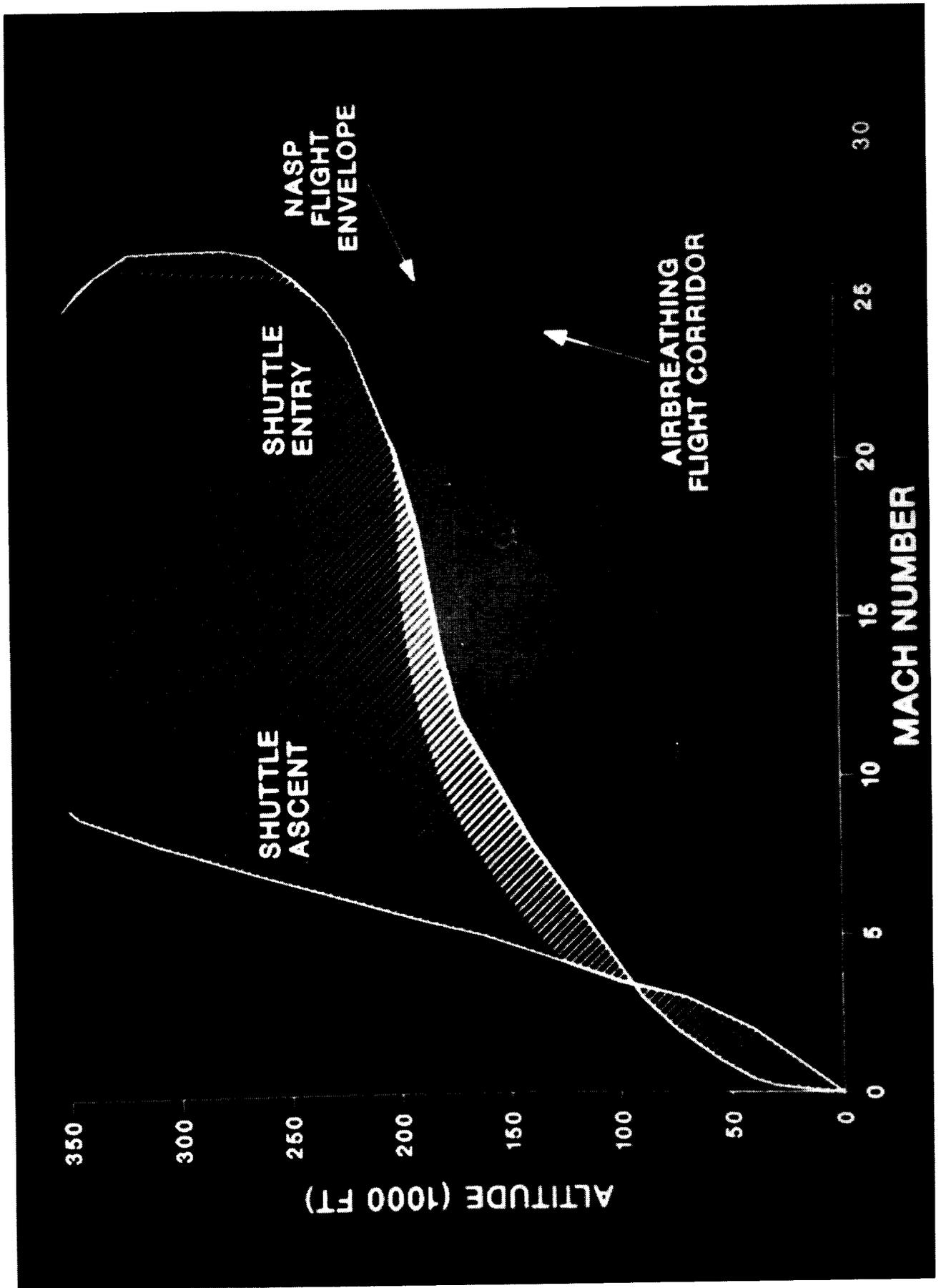
Boeing  
General Dynamics  
Lockheed  
McDonnell Douglas  
Rockwell

→ A  
→ C  
→ R  
→

General Dynamics  
McDonnell Douglas  
Rockwell

ECR/ACR  
Jul-Aug 87

Apr 90



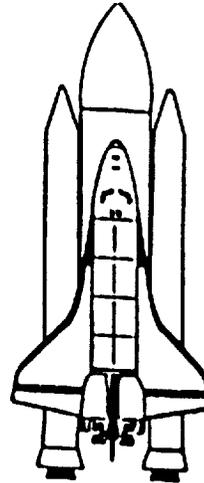
# AEROSPACE PLANE SHUTTLE COMPARISONS

**AEROSPACE PLANE**



- SINGLE STAGE TO ORBIT
- AIR-BREATHING PROPULSION
- HORIZONTAL TAKE-OFF  
FROM CONVENTIONAL RUNWAY
- ORBIT ON DEMAND
- ALTERNATE MISSION:  
HYPERSONIC CRUISE

**SPACE SHUTTLE**



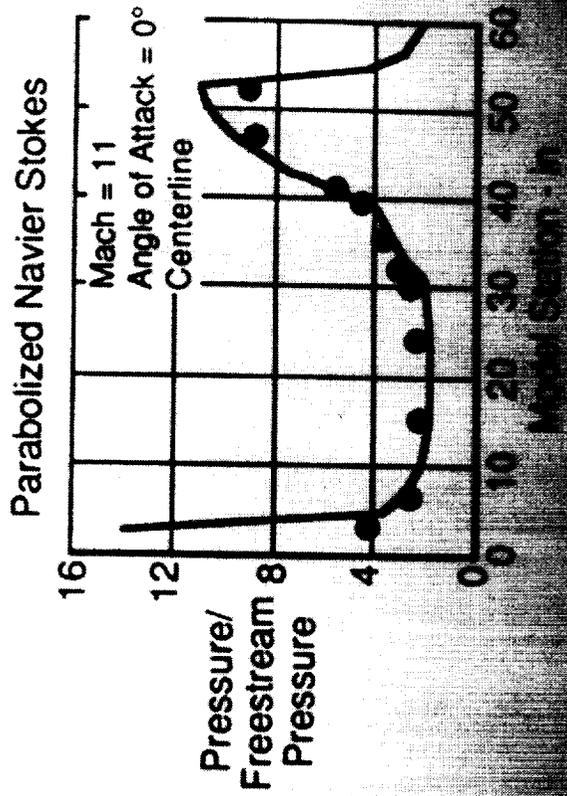
- MULTI-STAGE VEHICLE
- ROCKET PROPULSION
- VERTICAL TAKE-OFF -  
SPECIALIZED LAUNCH REQMTS
- WEEKS FOR LAUNCH PREPARATION
- NO ALTERNATE MISSION  
CAPABILITY

# NASP CONFIGURATION MATRIX

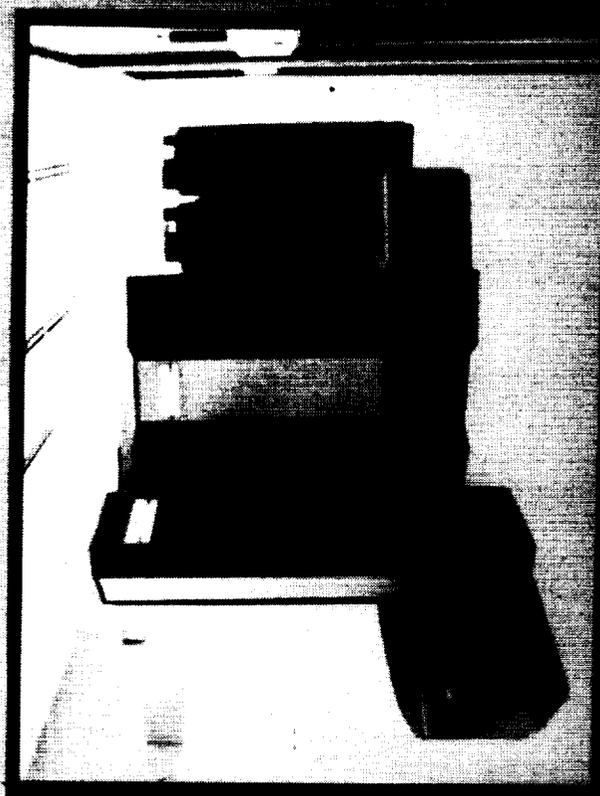
<p><b>WING / BODY</b></p> <hr/>  <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>-Low speed aero</li> <li>-Tankage design</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>-Wing/inlet coupling</li> <li>-Overexpanded flow to inlet</li> </ul>	<p><b>BLENDED BODY</b></p> <hr/>  <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>-Precompression efficiency</li> <li>-Structural weight</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>-Low speed aero</li> <li>-Elliptical tanks</li> </ul>
<p><b>CONICAL ACCELERATOR</b></p> <hr/>  <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>-Thrust margin</li> <li>-Precompression efficiency</li> <li>-Tankage design</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>-Sensitivity to angle of attack</li> <li>-Cruise efficiency</li> </ul>	<p><b>CONFINED FLOW FIELD</b></p> <hr/>  <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>-Precompression efficiency</li> <li>-Aero efficiency</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>-Structural weight</li> <li>-Thermal protection</li> <li>-Off-design sensitivity</li> </ul>

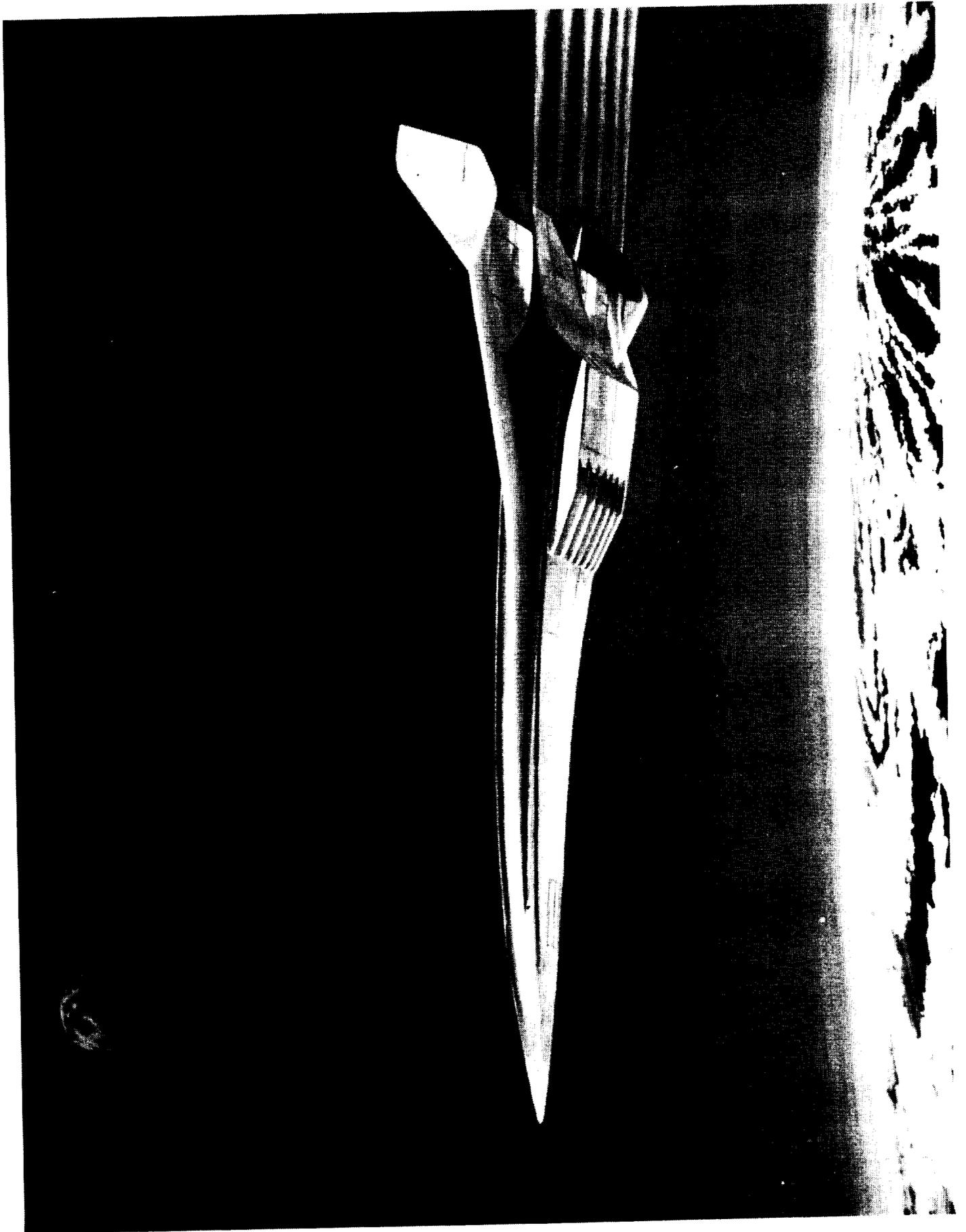


Model in Hypersonic Tunnel



Computational Fluid Dynamics





350

300

250

200

150

100

ALTITUDE (1000 FT)

ROCKET

AIRBREATHING  
FLIGHT CORRIDOR

SCRAMJET

RAMJET

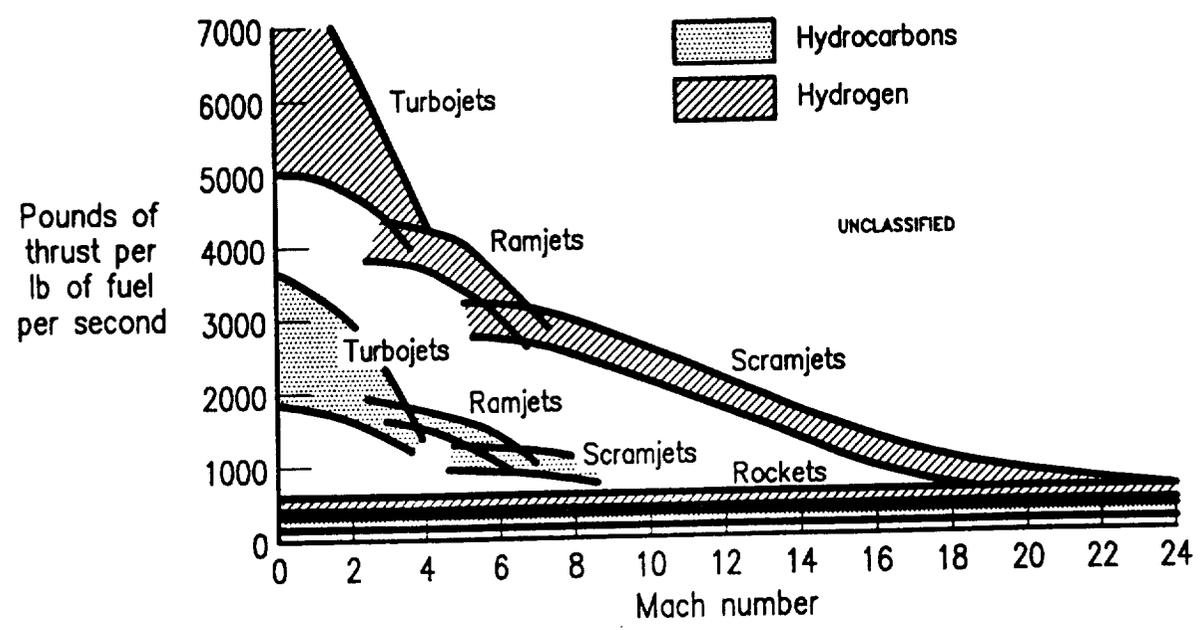
TURBOJET



UNCLASSIFIED

# PROPULSION OPTIONS (U)

## Fuel consumption comparison



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RACKET

MACH 2 TO 4

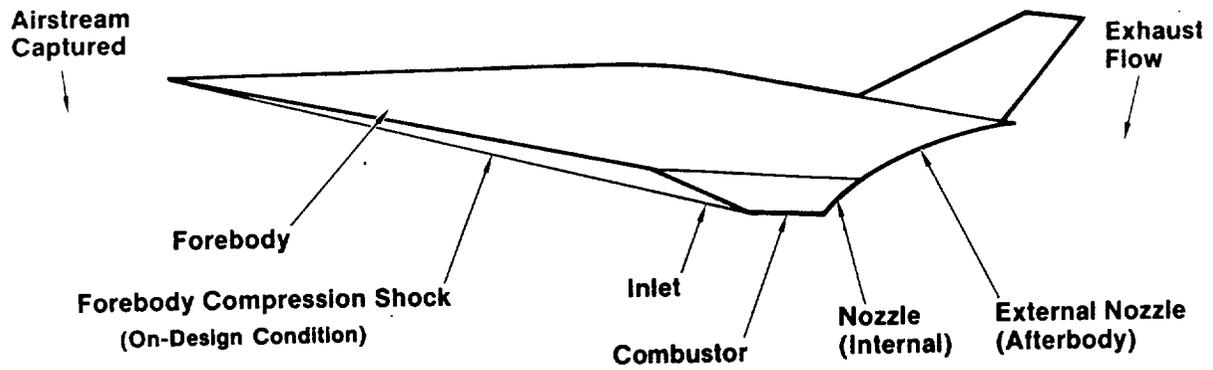
NORMAL SHOCK



SUBSONIC CORNER

4666 88W GWTB/2

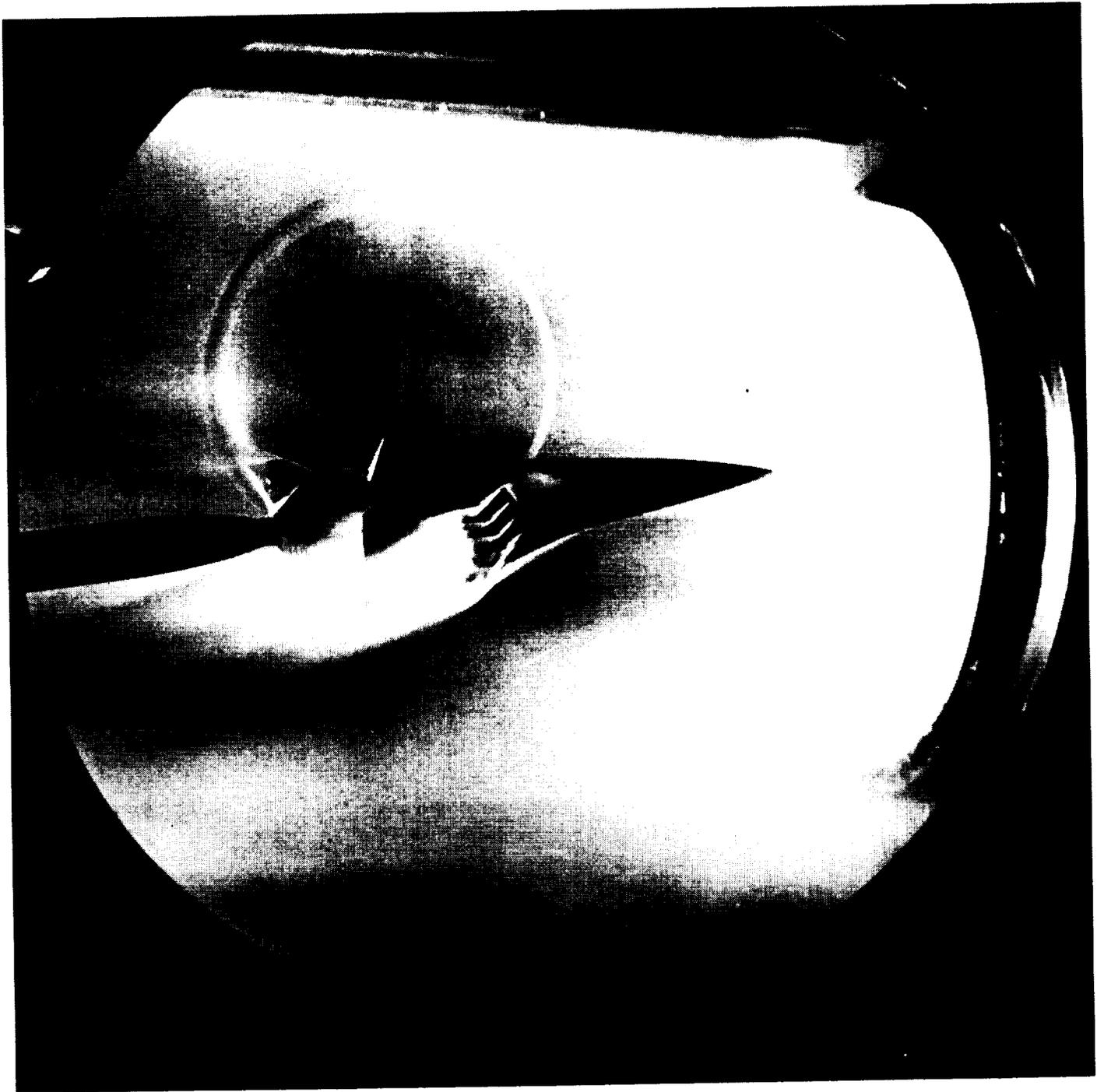
# Propulsion Concept High-Speed Scramjet



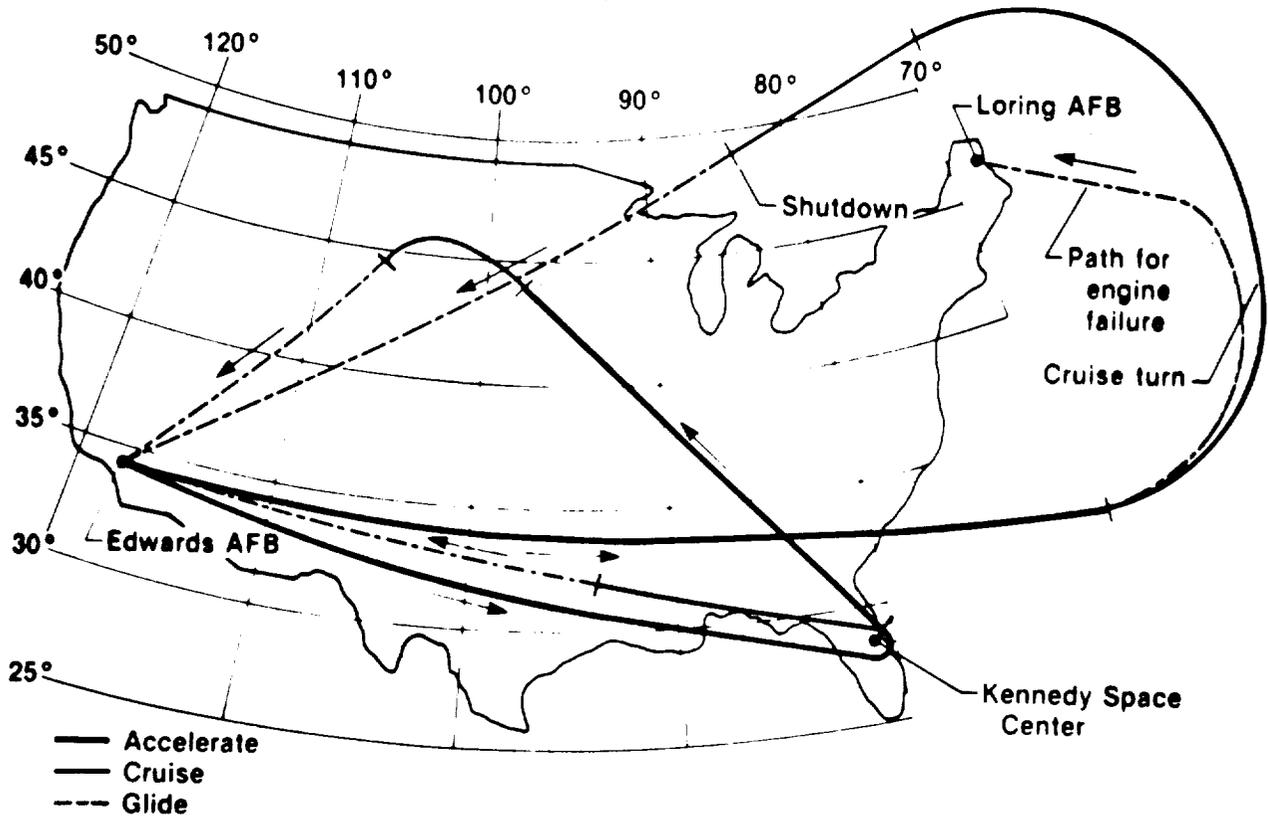
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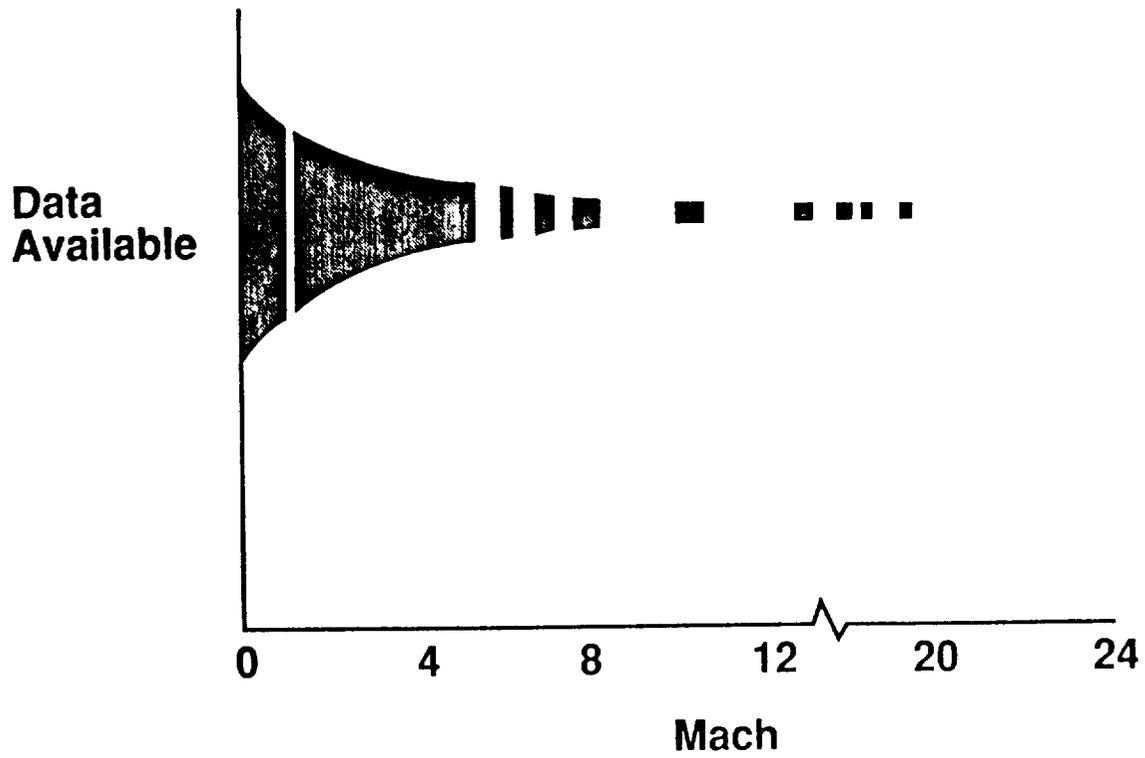


# Ground Track for Envelope Expansion (U)



## WIND TUNNEL DATA AVAILABLE FOR NASP (U)

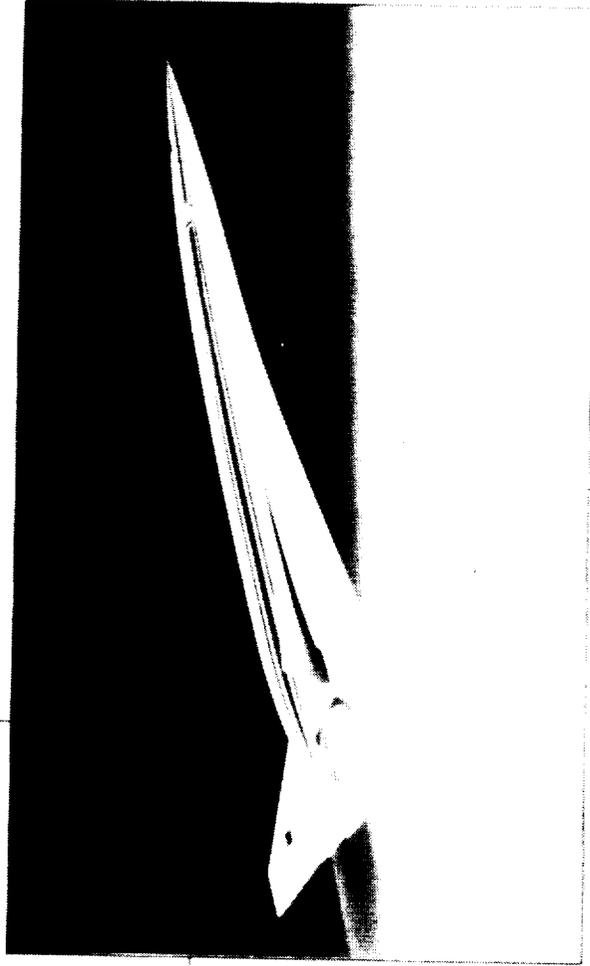
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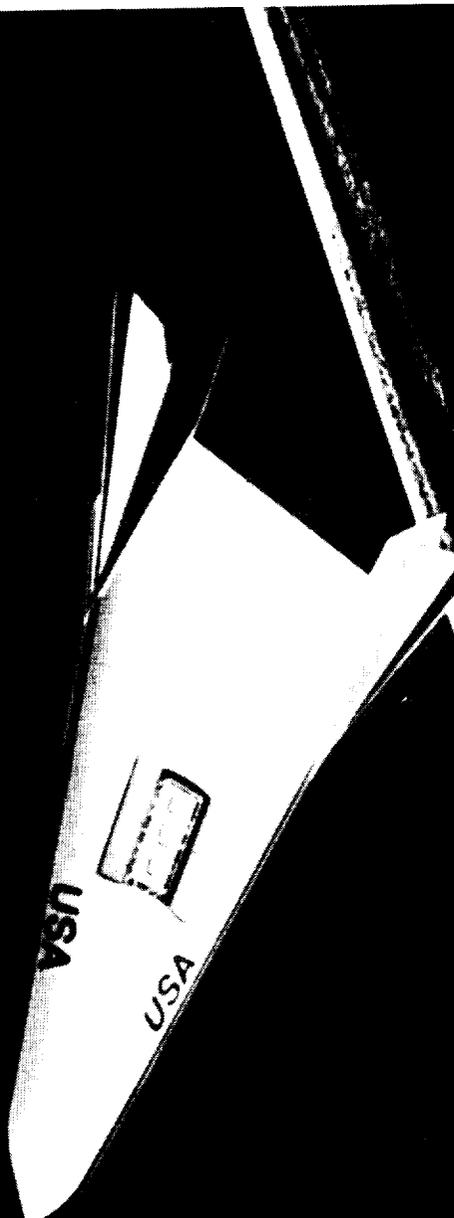


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NASA

OAST  
RN87 493(3)

Revolutionary  
Capability



Leadership in a  
World Economy



**PROPULSION SYSTEMS OPTIONS-  
FUTURISTIC SYSTEMS**



PRESENTATION 1.4.1

**NUCLEAR AND SOLAR ELECTRIC PROPULSION**

